



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/719,443	11/21/2003	Sreenivas Subramoney	42P17257	3029

8791 7590 07/03/2006

BLAKELY SOKOLOFF TAYLOR & ZAFMAN  
12400 WILSHIRE BOULEVARD  
SEVENTH FLOOR  
LOS ANGELES, CA 90025-1030

EXAMINER

CHANNAVAJJALA, SRIRAMA T

ART UNIT	PAPER NUMBER
----------	--------------

2166

DATE MAILED: 07/03/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/719,443	SUBRAMONEY ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	Srirama Channavajjala	2166	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 21 November 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-39 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-39 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 November 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |                                                                                                                        |                                                                                         |
|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                            | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____                                                |

### DETAILED ACTION

1. Claims 1-39 are presented for examination.

#### ***Drawings***

2. The Drawings filed on 11/21/2003 are acceptable for examination purpose only.

#### ***Claim Rejections - 35 USC § 101***

35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. ***Claims 1-36 are rejected under 35 U.S.C. 101 because invention is directed to non-statutory subject matter.***

#### ***As set forth in MPEP 2106(II)A:***

*Identify and understand Any Practical Application Asserted for the Invention. The claimed invention as a whole must accomplish a practical application. That is, it must produce a "useful, concrete and tangible result." State Street, 149 F.3d at 1373, 47USPQ2d at 1601-02. The purpose of this requirement is to limit patent protection to inventions that possess a certain level of "real world" value, as opposed to subject matter that represents nothing more than an idea or concept, or is simply a starting point for future investigation or research (Brenner v. Manson, 383 U.S. 519, 528-36, 148 USPQ 689, 693-96); In re Ziegler, 992, F.2d 1197, 1200-03, 26 USPQ2d 1600, 1603-06 (Fed. Cir. 1993)). Accordingly, a complete disclosure should contain some indication of the **practical application** for the claimed invention, i.e., why the applicant believes the claimed invention is useful.*

*Apart from the utility requirement of 35 U.S.C. 101, usefulness under the patent eligibility standard requires significant functionality to be present to satisfy the useful result aspect of the practical application requirement. See Arrhythmia, 958 F.2d at 1057, 22 USPQ2d at 1036. Merely claiming nonfunctional descriptive material **stored in a computer-readable medium does not make the invention eligible for patenting.** For example, a claim directed to a word processing **file stored on a disk may satisfy the utility** requirement of 35 U.S.C. 101 since the information stored may have some **"real world"** value. However, the mere fact that the claim may satisfy the utility requirement of 35 U.S.C. 101 **does not mean that a useful result is achieved under the practical application requirement. The claimed invention as a whole must produce a "useful, concrete and tangible" result to have a practical application.***

4. Regarding claim 1,25, "A method for performing concurrent mark-sweep garbage collection, comprising:

*receiving an application;*

*executing the application in at least one thread;*

*determining if available space in a heap falls below a threshold; performing mark-sweep garbage collection, concurrently while executing the application, in a heap block of the heap using a first bit vector, a second bit vector, a mark bit vector pointer, and a sweep bit vector pointer in the heap block, if the available space falls below the threshold; and otherwise,*

*continuing executing the application and monitoring if the available space in the*

Art Unit: 2166

*heap falls below the threshold, until the execution of the application is complete"*

is directed to "abstract idea" because all of the elements in the claim 1,25 would reasonably be interpreted by one of ordinary skill in light of the disclosure as software, such that the method is software, per se, is "non-statutory subject matter" and

**claim 1,25**, do not have "practical application" because the "final result" by the claimed invention in the claim 1,25, elements particularly *"determining if available space in a heap falls below a threshold; performing mark-sweep garbage collection, concurrently while executing the application, in a heap block of the heap using a first bit vector, a second bit vector, a mark bit vector pointer, and a sweep bit vector pointer in the heap block, if the available space falls below the threshold; and otherwise,*

*continuing executing the application and monitoring if the available space in the heap falls below the threshold, until the execution of the application is complete"* is not producing "useful, tangible and concrete" and therefore, claim 1,25 is a non-statutory subject matter.

The claimed invention is subject to the test of State Street, 149 F.3d at 1373-74, 47 USPQ2d at 1601-02. Specifically State Street sets forth that the claimed invention must produce a **"useful, concrete and tangible result."** The **Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility** states in section IV C. 2 b. (2) (on page 21 in the PDF format):

The tangible requirement does not necessarily mean that a claim must either be tied to a particular machine or apparatus or must operate to change articles or materials to a different state or thing. However, the tangible requirement does require that the claim must recite more than a § 101 judicial exception, in that the

Art Unit: 2166

process claim must set forth a practical application of that § 101 judicial exception to produce a real-world result. Benson, 409 U.S. at 71-72, 175 USPQ at 676-77 (invention ineligible because had “no substantial practical application.”).

Claims 1,25, have the result of producing “real-world” results related to “performing mark-sweep garbage collection” however the claim[s] do not specify that the result neither output nor displayed to a user or otherwise used in the real world, but does not output useful, concrete and tangible result. The examiner reviewed the specification page 13-19, but was unable to find a practical real-world use of the result (determining if available space in a heap falls below a threshold; performing mark-sweep garbage collection, concurrently while executing the application, in a heap block of the heap using a first bit vector, a second bit vector, a mark bit vector pointer, and a sweep bit vector pointer in the heap block, if the available space falls below the threshold; and otherwise,

continuing executing the application and monitoring if the available space in the heap falls below the threshold, until the execution of the application is complete).

If the applicant is able to find one and inserts it into the claims provide the location the element is found in the specification

The claims 2-11, 26-35, dependent from claim 1,25, is also rejected in the above analysis.

Art Unit: 2166

5. Regarding claim 12, 36, "A method for automatically collecting garbage objects, comprising:

receiving a first code;

compiling the first code into a second code;

executing the second code in at least one thread; and automatically performing mark-sweep garbage collection using bit vector toggling, concurrently with the executing second code, to ensure there is storage space available for executing the second code".

is directed to "abstract idea" because all of the elements in the claim 12,36, would reasonably be interpreted by one of ordinary skill in light of the disclosure as software, such that the method is software, per se, is "non-statutory subject matter" and

**claim 12,36**, do not have "practical application" because the "final result" by the claimed invention in the claim 12,36, elements particularly "executing the second code in at least one thread; and automatically performing mark-sweep garbage collection using bit vector toggling, concurrently with the executing second code, to ensure there is storage space available for executing the second code" is not producing "**useful, tangible and concrete**" and therefore, claim 12,36 is a non-statutory subject matter.

The claimed invention is subject to the test of State Street, 149 F.3d at 1373-74, 47 USPQ2d at 1601-02. Specifically State Street sets forth that the claimed invention must produce a "**useful, concrete and tangible result.**" The **Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility** states in section IV C. 2 b. (2) (on page 21 in the PDF format):

The tangible requirement does not necessarily mean that a claim must either be tied to a particular machine or apparatus or must operate to change articles or

Art Unit: 2166

materials to a different state or thing. However, the tangible requirement does require that the claim must recite more than a § 101 judicial exception, in that the process claim must set forth a practical application of that § 101 judicial exception to produce a real-world result. Benson, 409 U.S. at 71-72, 175 USPQ at 676-77 (invention ineligible because had “no substantial practical application.”).

Claim 12,36, have the result of producing “real-world” results related to “automatically performing mark-sweep garbage collection” however the claim[s] do not specify that the result neither output nor displayed to a user or otherwise used in the real world, but does not output useful, concrete and tangible result. The examiner reviewed the specification page 13-19, but was unable to find a practical real-world use of the result (executing the second code in at least one thread; and automatically performing mark-sweep garbage collection using bit vector toggling, concurrently with the executing second code, to ensure there is storage space available for executing the second code).

If the applicant is able to find one and inserts it into the claims provide the location the element is found in the specification

The claims 13-15, 37-39, dependent from claim 12,36 is also rejected in the above analysis



Art Unit: 2166

6. Regarding claim 16," A system for concurrent mark-sweep garbage collection, comprising:

a root set enumeration mechanism to enumerate references to live objects in a heap;

a live object tracing mechanism to parallel trace live objects in a heap block and mark the live objects in a first bit vector pointed to by a mark bit vector pointer in the heap block, concurrently with execution of an application; and

a garbage sweeping mechanism to sweep storage space occupied by garbage objects to make the storage space allocable using a second bit vector pointed to by a sweep bit vector pointer in the heap block, concurrently with the execution of the application and live object marking"; is directed to "abstract idea" because all of the elements in the claim 16 would reasonably be interpreted by one of ordinary skill in light of the disclosure as software, such that the concurrent mark-sweep garbage collection is software, per se , is "non-statutory subject matter" and **claim 16** do not have "practical application" because the "final result" by the claimed invention in the claim 16 elements particularly "a garbage sweeping mechanism to sweep storage space occupied by garbage objects to make the storage space allocable using a second bit vector pointed to by a sweep bit vector pointer in the heap block, concurrently with the execution of the application and live object marking" is not producing "useful, tangible and concrete" and therefore, claim 16 is a non-statutory subject matter.

The claimed invention is subject to the test of State Street, 149 F.3d at 1373-74, 47 USPQ2d at 1601-02. Specifically State Street sets forth that the claimed invention

must produce a ***“useful, concrete and tangible result.”*** The **Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility** states in section IV C. 2 b. (2) (on page 21 in the PDF format):

The tangible requirement does not necessarily mean that a claim must either be tied to a particular machine or apparatus or must operate to change articles or materials to a different state or thing. However, the tangible requirement does require that the claim must recite more than a § 101 judicial exception, in that the process claim must set forth a practical application of that § 101 judicial exception to produce a real-world result. Benson, 409 U.S. at 71-72, 175 USPQ at 676-77 (invention ineligible because had “no substantial practical application.”).

Claims 16 have the result of producing “real-world” results related to “performing mark-sweep garbage collection” however the claim[s] do not specify that the result neither output nor displayed to a user or otherwise used in the real world, but does not output useful, concrete and tangible result. The examiner reviewed the specification page 15-19, fig 8, but was unable to find a practical real-world use of the result (a garbage sweeping mechanism to sweep storage space occupied by garbage objects to make the storage space allocable using a second bit vector pointed to by a sweep bit vector pointer in the heap block, concurrently with the execution of the application and live object marking). If the applicant is able to find one and inserts it into the claims provide the location the element is found in the specification

The claims 17-18 dependent from claim 16 is also rejected in the above analysis.

Art Unit: 2166

7. Regarding claim 19, “A *managed runtime system, comprising:*

*a just-in-time compiler to compile an application into a code native to an underlying computing platform;*

*a virtual machine to execute the application; and*

*a garbage collector to trace live objects, mark the live objects in a first bit vector pointed to by a mark bit vector pointer in a heap block of a heap, and toggle the bit first vector pointed to by the mark bit vector pointer with a second bit vector pointed to by a sweep bit vector pointer at the end of marking phase, concurrently with execution of the application”;* is directed to “abstract idea” because all of the elements in the claim 19

would reasonably be interpreted by one of ordinary skill in light of the disclosure as

software, such that the managed runtime system comprising a just-in-time compiler to

compile an application in a garbage collection to trace live objects is software, per se ,

is “non-statutory subject matter” and **claim 19** do not have “practical application”

because the “final result” by the claimed invention in the claim 19 elements particularly

“a garbage collector to trace live objects, mark the live objects in a first bit vector

pointed to by a mark bit vector pointer in a heap block of a heap, and toggle the bit first

vector pointed to by the mark bit vector pointer with a second bit vector pointed to by a

sweep bit vector pointer at the end of marking phase, concurrently with execution of the

application” is not producing “useful, tangible and concrete” and therefore, claim 19 is

a non-statutory subject matter.

The claimed invention is subject to the test of State Street, 149 F.3d at 1373-74, 47 USPQ2d at 1601-02. Specifically State Street sets forth that the claimed invention

must produce a ***“useful, concrete and tangible result.”*** The **Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility** states in section IV C. 2 b. (2) (on page 21 in the PDF format):

The tangible requirement does not necessarily mean that a claim must either be tied to a particular machine or apparatus or must operate to change articles or materials to a different state or thing. However, the tangible requirement does require that the claim must recite more than a § 101 judicial exception, in that the process claim must set forth a practical application of that § 101 judicial exception to produce a real-world result. Benson, 409 U.S. at 71-72, 175 USPQ at 676-77 (invention ineligible because had “no substantial practical application.”).

Claims 19 have the result of producing “real-world” results related to “mark the live objects in a first bit vector pointed to by a mark bit vector pointer in a heap block in a garbage collector” however the claim[s] do not specify that the result neither output nor displayed to a user or otherwise used in the real world, but does not output useful, concrete and tangible result, but merely execution of the application. The examiner reviewed the specification page 6-8, page 11-13, fig 1-2, but was unable to find a practical real-world use of the result (a garbage collector to trace live objects, mark the live objects in a first bit vector pointed to by a mark bit vector pointer in a heap block of a heap, and toggle the bit first vector pointed to by the mark bit vector pointer with a second bit vector pointed to by a sweep bit vector pointer at the end of marking phase, concurrently with execution of the application). If the applicant is able to find one and inserts it into the claims provide the location the element is found in the specification

The claims 20-21 dependent from claim 16 is also rejected in the above analysis.

Art Unit: 2166

8. Regarding claim 22, "A computer-readable medium having stored thereon a data structure comprising:

*a first field containing a first pointer pointing to a mark bit vector in a heap block of a heap;*

*a second field containing a second pointer pointing to a sweep bit vector in the heap block;*

*a third field containing a first bit vector representing at least one of marking and sweeping statuses of objects stored in the heap block; and*

*a fourth field containing a second bit vector representing at least one of marking and sweeping statuses of objects stored in the heap block";* is directed to "abstract idea" because all of the elements in the claim 22 would reasonably be interpreted by one of ordinary skill in light of the disclosure as software, such that the data structure comprising: pointer to mark bit vector in a heap block of a heap" is software, per se , merely code or instructions or a data structure [the IEEE definition of which can be found in the Interim Guidelines, Annex IV, page 50, and the in MPEP 2106], or merely non-functional descriptive material for example data or non-functional arrangement of first field containing a first pointer, a second field containing a second pointer, a third field containing a first bit vector.....is non-functional descriptive language because even when claimed as stored appropriate medium but not producing "**useful, tangible and concrete**" result is "non-statutory subject matter" and **claim 22** do not have "practical application" because the "final result" by the claimed invention in the claim 22 elements particularly "pointer pointing to a mark bit vector in a heap block " is not

Art Unit: 2166

producing “useful, tangible and concrete” and therefore, claim 22 is a non-statutory subject matter.

The claimed invention is subject to the test of State Street, 149 F.3d at 1373-74, 47 USPQ2d at 1601-02. Specifically State Street sets forth that the claimed invention must produce a **“useful, concrete and tangible result.”** The **Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility** states in section IV C. 2 b. (2) (on page 21 in the PDF format):

The tangible requirement does not necessarily mean that a claim must either be tied to a particular machine or apparatus or must operate to change articles or materials to a different state or thing. However, the tangible requirement does require that the claim must recite more than a § 101 judicial exception, in that the process claim must set forth a practical application of that § 101 judicial exception to produce a real-world result. Benson, 409 U.S. at 71-72, 175 USPQ at 676-77 (invention ineligible because had “no substantial practical application.”).

Claims 22 have the result of producing “real-world” results related to “pointing to a mark bit vector in a heap block” however the claim[s] do not specify that the result neither output nor displayed to a user or otherwise used in the real world, but does not output useful, concrete and tangible result. The examiner reviewed the specification page 10-13, fig 4,6,9, but was unable to find a practical real-world use of the result (a *first field containing a first pointer pointing to a mark bit vector in a heap block of a heap; a second field containing a second pointer pointing to a sweep bit vector in the heap block; a third field containing a first bit vector representing at least one of marking and sweeping statuses of objects stored in the heap block; and a fourth field containing a*

*second bit vector representing at least one of marking and sweeping statuses of objects stored in the heap block).* If the applicant is able to find one and inserts it into the claims provide the location the element is found in the specification

The claims 23-24 dependent from claim 16 is also rejected in the above analysis

**For “General Analysis for Determining Patent-Eligible Subject Matter”, see 101 Interim Guidelines as indicated below:**

<<<http://www.uspto.gov/web/offices/pac/dapp/ogsheet.html>>>

**No new matter should be entered**

### ***Double Patenting***

9. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

*A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double*

*patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).*

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

10. Claims 1,12,16,19,22,25,36 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1,17,24,29,32 of co pending Application No. **10/793,707**, filed on 3/3/2004, although the conflicting claims are not identical, they are not patentably distinct from each other because in the ***co-pending*** application Independent ***Claims 1***, directed to ***"A method for performing mark-sweep compact garbage collection comprising:***

*receiving an application;*

*executing the application in at least one thread;*

*determining if available space in a heap falls below a threshold; performing mark-sweep-compact garbage collection in the heap using a bit vector for each heap block for marking, sweeping, and compacting, if the available space falls below the threshold; and otherwise,*

*continuing executing the application and monitoring if the available space in the heap falls below the threshold; **wherein the heap comprises at least one heap block and a heap block comprises only one bit vector**"*



Art Unit: 2166

while instant application [10/719,443] **claim 1 is directed to:** *A method for performing concurrent mark-sweep garbage collection, comprising:*

*receiving an application;*

*executing the application in at least one thread;*

*determining if available space in a heap falls below a threshold;*

*performing mark-sweep garbage collection, concurrently while executing the application, in a heap block of the heap using a first bit vector, a second bit vector, a mark bit vector pointer, and a sweep bit vector pointer in the heap block, if the available space falls below the threshold; and otherwise,*

*continuing executing the application and monitoring if the available space in the heap falls below the threshold, until the execution of the application is complete*

It would have been obvious one of the ordinary skill in the art at the time of the applicant's invention to add or drop limitation in order to arrive at the same results, for example in the present application continuing executing the application and monitoring, if the available space in the heap falls the threshold; wherein the heap comprises at least one heap block and a heap block comprises only one bit vector", while co-pending application claim limitation " *continuing executing the application and monitoring if the available space in the heap falls below the threshold; wherein the heap comprises at least one heap block and a heap block comprises only one bit vector*" **is not patentably distinct from the instant application.** Accordingly, the instant application claims are within the scope of the Claims of the Application No. 10/793,707.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

***Claim Rejections - 35 USC § 102***

11. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

***12. Claims 1-11,22-35 are rejected under 35 U.S.C. 102(b) as being anticipated by Kuiper, US Patent. No. 6324631, published on Nov 27,2001.***

13. As to claim 1,25, Kuiper teaches a system which including 'a method for performing concurrent mark-sweep garbage collection' [col 1, line 40-42,line 52-55], Kuiper specifically teaches "mark-sweep" method particularly mark-sweep garbage collector implementation as detailed in col 1, line 40-42, line 52-55 ;

'receiving an application; executing the application in at least one thread' [col 4, line 1-4,, col 5, line 10-14], Kuiper teaches object oriented environment particularly, JAVA program applications incorporating objects i.e., application programming interface allows receiving an application and executing the application , further in the garbage collector is typically described as "mark/sweep garbage supports executing the

Art Unit: 2166

application in thread in relation with memory management as detailed in col 4, line 1-4, col 5, line 10-14;

determining if available space in a heap falls below a threshold' [col 4, line 5-12, col 6, line 7-10, col 9, line 1-7], Kuiper specifically teaches threshold value is defined and set to specific value allocating the memory segments and memory heap, further, as detailed in col 4, line 5-12, col 6, line 7-10, col 9, line 1-7;

' performing mark-sweep garbage collection [col 2, line 9-10, fig 5A-5B], concurrently while executing the application, in a heap block of the heap using a first bit vector, a second bit vector, a mark bit vector pointer [col 5, line 39-48, line 51-52], Kuiper specifically teaches memory data structure in the mark-sweep garbage collection, particularly, mark bit array describing about each object within a corresponding respective portion of the memory as detailed in fig 2, col 5, line 39-48, further during the mark phase, specific bit is assigned or set corresponding to the beginning of each live object with the memory heap as detailed in col 5, line 51-52;

'a sweep bit vector pointer in the heap block, if the available space falls below the threshold; and otherwise, continuing executing the application and monitoring if the available space in the heap falls below the threshold, until the execution of the application is complete' [col 6, line 52-64, col 7, line 21-30], Kuiper teaches sweep phase with respect to memory segments and sequence of bit position, more specifically, sweep phase determines the memory segments associated with mark bits and bit positions and compared with the threshold size that allows to identify regions of memory to balance the speed of the memory sweep as detailed in col 7, line 21-30 .

Art Unit: 2166

14. As to claim 2, 26, Kuiper disclosed 'the heap comprises at least one heap block' [col 8, line 58-63].

15. As to claim 3, 27, Kuper disclosed 'initializing a concurrent mark-sweep garbage collector' [col 5, line 39-43].

16. As to claim 4, 28, Kuiper disclosed initializing the concurrent mark-sweep garbage collector comprises setting each bit in the first bit vector and the second bit vector to 0, and pointing the mark bit vector pointer to the first bit vector and the sweep bit vector pointer to the second bit vector' [col 5, line 59-65, line 19-21].

17. As to claim 5, 29, Kuiper disclosed 'performing mark-sweep garbage collection comprises: invoking at least one garbage collection thread to trace live objects in the heap block concurrently while executing the application' [col 5, line 39-41, col 6, line 57-61];

'reclaiming storage space occupied by objects other than the live objects in the block concurrently while tracing the live objects in the block and executing the application' [col 6, line 61-67].

18. As to claim 6, 30, Kuiper disclosed 'tracing the live objects in the heap block comprises parallel marking the live objects by at least one garbage collection thread' [col 1, line 52-56].

Art Unit: 2166

19. As to claim 7, 31, Kuiper disclosed 'parallel marking the live objects comprises setting bits corresponding to starting addresses of the live objects in a bit vector pointed to by the mark bit vector pointer to 1, by the at least one garbage collection thread' [col 4, line 9-18].

20. As to claim 8, 32, Kuiper disclosed 'reclaiming the storage space occupied by objects other than the live objects in the heap block comprises sweeping the heap block to make the said storage space allocable by using a bit vector pointed to by the sweep bit vector pointer' col 6, line 43-47, line 52-61][.

21. As to claim 9, 33, Kuiper disclosed 'toggling a bit vector pointed to by the mark bit vector pointer with a bit vector pointed to by the sweep bit vector pointer after marking the live objects in the heap block is complete' [col 6, line 29-37].

22. As to claim 10, 34, Kuiper disclosed 'setting the bit vector back to 0 after completing sweeping the heap block' [col 5, line 62-65].

23. As to claim 11, 35, Kuiper disclosed 'performing another cycle of concurrent mark-sweep garbage collection when available space in the heap falls below the threshold again' [col 7, line 43-53, line 59-64].

Art Unit: 2166

24. As to claim 22, Kuiper teaches a system which including 'a computer-readable medium having stored thereon a data structure comprising:

a first field containing a first pointer pointing to a mark bit vector in a heap block of a heap' [fig 2, col 5, line 39-43, col 6, line 29-33], Kuiper is directed to garbage collection, more specifically, mark/sweep algorithm is specific type of garbage collection, Kuiper also teaches data structure particularly dealing with mark-sweep collection, further mark bit array data structure with associated memory segments as detailed in fig 2;

a second field containing a second pointer pointing to a sweep bit vector in the heap block [fig 2, col 5, line 39-43, col 6, line 55-61], Kuiper specifically teaches sweep phase memory segments that corresponds to the sequence as detailed in col 6, line 55-61;

a third field containing a first bit vector representing at least one of marking and sweeping statuses of objects stored in the heap block' [col 7, line 35-42, col 8, line 10-16], Kuiper specifically teaches mark/sweep garbage collection particularly sweep process and mark process functions both allocating and de-allocating free space that determines the status of the marking and sweeping by setting the bits as detailed in col 7, line 35-42, col 8, line 10-16;

a fourth field containing a second bit vector representing at least one of marking and sweeping statuses of objects stored in the heap block' [col 8, line 58-63, col 9, line 1-15].

Art Unit: 2166

25. As to claim 23, Kuiper disclosed 'the data structure is stored in a header area of the heap block of the heap' [col 5, line 39-43, fig 2]..

26. As to claim 24, Kuiper disclosed the first pointer is initially pointed to the first bit vector and the second pointer is initially pointed to the second bit vector [col 5, line 59-65], when garbage collector is initialized; and the first bit vector and the second bit vector are toggled after the heap block is marked [col 5, line 66-67, col 6, line 1-6].

27. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

**28. Claims 12-15,19-21, 36-39 are rejected under 35 U.S.C. 102(a) as being anticipated by Czajkowski, US Patent No. 6594749 , published on July 15, 2003.**

29. As to claim 12, 36, Czajkowski disclosed 'automatically collecting garbage objects' [col 1, line 60-67, col 2, line 1-3], automatically collecting garbage objects corresponds to Czajkowski's automatic garbage collection is part of the run-time system as detailed in col 1, line 60-67;

receiving a first code; compiling the first code into a second code; executing the second code in at least one thread' [col 2, line 41-49, col 3, line 39-41, col 3, line 57-60], Czajkowski specifically teaches object oriented program that executing set of methods

Art Unit: 2166

for garbage collection particularly related to memory requirements, furthermore, memory blocks may be allocated from the heap, it is noted that heap for memory allocations based on the data structure particularly memory blocks, also available free space amount per allocating thread for executing processor is part of the Czajkowski's teaching [col 3, line 23-30].

'automatically performing mark-sweep garbage collection using bit vector toggling' [col 1, line 32-36, col 2, line 16-20, col 7, line line 34-37], 'concurrently with the executing second code, to ensure there is storage space available for executing the second code' [col 2, line 61-65,.col 7, line 24-34].

30. As to claim 13, 37, Czajkowski disclosed 'automatically performing mark-sweep garbage collection using bit vector toggling comprises detecting if available space in a heap falls below a threshold and invoking the concurrent mark-sweep garbage collection when the available space falls below the threshold [col 1, line 60-67, col 2, line 1-2]..

31. As to claim 14, 38, Czajkowski 'disclosed ' the heap comprises at least one heap block' [col 3, line 17-18].

32. As to claim 15, 39, Czajkowski' disclosed 'two bit vectors for a heap block, one for marking and the other for sweeping, and toggling the two bit vectors after marking phase for the heap block is complete' [col 6, line 23-36]..



Art Unit: 2166

33. As to claim 19, Czajkowski teaches a system which including 'a managed runtime system, comprising: a just-in-time compiler to compile an application into a code native to an underlying computing platform' [fig 6, col 10, line 35-45], Czajkowski specifically teaches Java based classes and Java base API, further, it is noted that just-in-time or JIT compiler, which converts the given bytecode sequences "on the fly" into an equivalent sequence of the native code of the underlying machine such as detailed in fig 6

'a virtual machine to execute the application' [fig 6, col 10, line 1-17], a virtual machine corresponds to Czajkowski's fig 6, element 622;

'a garbage collector to trace live objects, mark the live objects in a first bit vector pointed to by a mark bit vector pointer in a heap block of a heap [col 7, line 2-21], and toggle the bit first vector pointed to by the mark bit vector pointer with a second bit vector pointed to by a sweep bit vector pointer at the end of marking phase, concurrently with execution of the application' [col 7, line 24-37, line 64-67, col 8, line 1-18].

34. As to claim 20, Czajkowski disclosed 'a garbage sweeping mechanism to sweep storage space occupied by garbage objects to make the storage space allocable using a bit vector pointed to by the sweep bit vector pointer, concurrently with the execution of the application and live objects marking' [col 8, line 48-60].

Art Unit: 2166

35. As to claim 21, Czajkowski disclosed 'garbage collector comprises: a live object marking mechanism to parallel mark the live objects in the first bit vector pointed to by the mark bit vector in the heap block of the heap; and a bit vector toggling mechanism to toggle the first bit vector pointed to by the mark bit vector pointer and the second bit vector pointed to by the sweep bit vector pointer' [col 9, line 34-45]..

**36. *Claims 16-18 are rejected under 35 U.S.C. 102(e) as being anticipated by Andreasson , US Pub. No. 2004/0073764 filed on July 30,2003.***

37. As to claim 16, Andreasson teaches a system which including 'a system for concurrent mark-sweep garbage collection, comprising: a root set enumeration mechanism to enumerate references to live objects in a heap' [page 6, 0121, page 8, 0150], Andreasson specifically teaches garbage collections that including reference counting particularly using pointers to each memory object or root reference locations, mark-sweep and copying storage , also it is noted that garbage collector marks all objects from the found roots as detailed in page 8, 0150;

a live object tracing mechanism to parallel trace live objects in a heap block and mark the live objects in a first bit vector pointed to by a mark bit vector pointer in the heap block, concurrently with execution of an application' [page 6, col 2, 0123,page 8, 0151-0152], Andereasson specifically teaches concurrently checking and tracking the objects that including new objects, also marks live objects as detailed in page 8, col 1, 0152; ;

'a garbage sweeping mechanism to sweep storage space occupied by garbage objects to make the storage space allocable using a second bit vector pointed to by a sweep bit vector pointer in the heap block, concurrently with the execution of the application and live object marking' [page 6, 0123, page 8, 0156].

38. As to claim 17, Anderasson disclosed 'a bit vector toggling mechanism to toggle the first bit vector pointed to by the mark bit vector pointer and the second bit vector pointed to by the sweep bit vector pointer in the heap block' [page 7, 0132-0133].

39. As to claim 18, Anderasson disclosed 'live object tracing mechanism comprises: a live object search mechanism to parallel search live objects in a heap block by at least one garbage collection thread' [page 7, 0137];

'a live object marking mechanism to parallel mark the live objects in a bit vector stored in the heap block by the at least one garbage collection thread' [page 7, 0139];

'a live object scanning mechanism to parallel scan any objects reachable from the live objects in the heap; and a conflict prevention mechanism to prevent more than one garbage collection thread from marking the same object' [page 8, 0144].

***Conclusion***

***The prior art made of record***

- |    |               |              |
|----|---------------|--------------|
| a. | US Patent.No. | 6324631      |
| b. | US Pub.No.    | 2004/0073764 |
| c. | US Patent No. | 6594749      |

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Srirama Channavajjala whose telephone number is 571-272-4108. The examiner can normally be reached on Monday-Friday from 8:00 AM to 5:30 PM Eastern Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alam, Hosain, T, can be reached on (571) 272-3978. The fax phone numbers for the organization where the application or proceeding is assigned is 571-273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free)

sc  
*Patent Examiner.*  
June 22, 2006.

  
SRIRAMA CHANNAVAJJALA  
PRIMARY EXAMINER